

**Integrated Trail Planning
Guidelines for Wildlife,
Recreation, and Fish Resources
on
The Mt. Hood National Forest**

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ABSTRACT

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TITLE: Integrated Trail Planning Guidelines for Wildlife, Recreation, and Fish Resources on the Mt. Hood National Forest.

ABSTRACT: The Mt. Hood National Forest provides a wide variety of trail opportunities for various users. This forest also provides valuable wildlife and fish habitat for a multitude of species. One of the challenges facing managers on the Mt. Hood National Forest is to integrate into the Forest Plan the needs of a diverse and increasing recreating public and the habitat needs of fish and wildlife.

Integrating these needs can be accomplished through a four-stage approach:

1. Identify key fish and wildlife species, and sensitive habitats.
2. Develop trail planning guidelines that address these critical needs, and sensitive habitats.
3. Develop trail planning guidelines that emphasize positive fish and wildlife interactions with recreation trail users and interpretive opportunities.
4. Identify monitoring procedures to test the effectiveness of trail planning guidelines, and validate assumptions.

The goal of this project is to integrate fully the recreation, fish and wildlife resources into trail planning on the Mt. Hood National Forest. The key to achieving this goal is to recognize that meeting trail users needs, and fish and wildlife needs, can be mutually beneficial.

Keywords: Trail Planning, Key Species, Sensitive Habitats, Customer Satisfaction.

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EXECUTIVE SUMMARY

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SUMMARY: This report describes guidelines for planning trails in areas that contain key fish and wildlife species and sensitive habitats, including people habitats. This paper is composed of an introduction; a review of the current literature; identification of key species, sensitive habitats, and trail planning guidelines; monitoring procedures, future research needs, and a summary. This executive summary provides a brief synopsis of the seven sections.

INTRODUCTION:

The Mt. Hood National Forest provides a wide variety of trail opportunities for various users in an "Urban Forest" environment. This Forest also provides valuable fish and wildlife habitat for a multitude of species. Successful implementation of the Forest Plan will partially depend on integrating the needs of recreation trail users, and the needs of wildlife and fish species.

The goal of this project is to integrate fully the recreation, fish, and wildlife resources into trail planning on the Mt. Hood National Forest.

To achieve the goal, four objectives were developed:

1. Identify key fish and wildlife species, and sensitive habitats.
2. Develop trail planning guidelines that address the critical needs of key fish and wildlife species, sensitive habitats and trail users.
3. Develop trail planning guidelines that emphasize positive fish and wildlife interactions with recreation trail users and interpretive opportunities.
4. Identify monitoring procedures to test the effectiveness of trail planning guidelines and validate assumptions.

The scope of this project focuses on wildlife and fish and trail interactions on managed trail systems in forested settings. A managed trail system includes the trail as well as associated campgrounds and trailheads.

LITERATURE REVIEW:

The current literature was reviewed to identify documented interactions between fish, wildlife, and trail associated recreation in forested settings. There is an obvious lack of quantifiable documentation to distinguish differences between effects of motorized and non-motorized trail recreation on wildlife and fish in the forested Pacific Northwest. Consequently, this report considered human disturbance to include motorized and non-motorized effects equally, unless specifically noted.

METHODOLOGY:

This project approached the challenge of integrating fish, wildlife, and recreation trails by identifying key species, sensitive habitats and planning guidelines.

Key Species

Fifteen key species were identified on the Mt. Hood N.F. These species are either: (1) potentially very sensitive to recreation trail use; (2) represented significant ecological or economic importance; and/or (3) represented a unique, limited, or sensitive habitat. For each key species, the specie's life history is briefly described, potential interactions with recreation trails were identified, and the critical period for potential impacts was identified.

Sensitive Habitats

Twelve sensitive habitats were identified on the Mt. Hood National Forest. These habitats are either: (1) ecologically unique; (2) potentially very sensitive to associated trail use; and/or (3) provide essential habitat for a key species during a critical period. For each sensitive habitat, the physical attributes were described, importance of the habitat to fish or wildlife was determined, potential interactions were identified, and the critical period of potential impacts was described. People or recreationist habitats in relation to fish and wildlife habitats were also described.

Trail Planning Guidelines

Trail planning guidelines were developed to address the interactions between trail-associated recreation and each key species and sensitive habitat, including people habitat. The trail planning guidelines are designed to provide high quality trail settings and interpretive opportunities, while managing the potential fish and wildlife interactions. This project demonstrates that protecting fish and wildlife, and people habitat is mutually beneficial. Trails designed to meet users' needs will encourage on-trail use and discourage off-trail use, thereby protecting fish and wildlife habitat.

MONITORING:

Development of a monitoring plan was the final step to integrating trail recreation opportunities with fish and wildlife resources on the Mt. Hood National Forest. Throughout the discussions of key species, sensitive habitats and trail planning guidelines, assumptions were made. These assumptions involved predicting the type of potential interactions between recreation trails and fish and wildlife, and suggesting management practices to minimize or eliminate the negative impacts and enhance the positive interactions.

The objective of the monitoring plan is to test the validity of assumptions made during identification of key species, sensitive habitats and trail planning guidelines. This plan outlines the monitoring method, unit of measure, monitoring frequency and threshold of variability for each key species and sensitive habitat.

FUTURE RESEARCH NEEDS:

The lack of quantifiable information concerning interactions between associated trail recreation and fish and wildlife is a large obstacle to providing customer satisfaction on the Mt. Hood National Forest. Trail opportunities are often restricted based on subjective or undocumented information. During the course of developing this project, several questions arose that could logically lead to future research projects. High priority research needs include identification of the differences between types and intensities of associated trail use and interactions with fish and wildlife; and the positive relationship between providing high quality trail settings and protecting fish and wildlife habitat.

SUMMARY:

Future successful resource management and public support for Forest Service programs will depend on satisfying the National Forest's customers. This project provides the framework for resource managers on the Mt. Hood National Forest to integrate fish and wildlife, and recreation resources in a publicly acceptable manner.

I. INTRODUCTION

The Mt. Hood National Forest, Pacific Northwest Region, provides a variety of trail opportunities for Off Road Vehicle (ORV), mountain bicycle, pedestrian, and equestrian uses. This Forest also provides valuable habitat for a multitude of wildlife and fish species. As the demand for trail opportunities increases, competition for space with wildlife and fish also increases, thereby raising the potential for interactions between trail users and wildlife.

One of the challenges facing managers on the Mt. Hood National Forest is satisfying the diverse trail-using public with high quality trail opportunities and still protecting the valuable fish and wildlife populations and habitat. Successful implementation of the Forest Plan will require the total integration of recreation and fish and wildlife resource values on a common land base.

One way to integrate these resource values is to approach trail planning from a customer service perspective. The Mt. Hood customers desire high quality trail opportunities and high quality fish and wildlife habitat (Oregon Statewide Comprehensive Outdoor Recreation Plan, 1988; Pacific Northwest Demand Survey, 1987). It is the contention of this project that in order to maintain high quality fish and wildlife habitat for future generations, people need to access, experience, and learn about those habitats. By allowing people to experience fish and wildlife habitats through different forms of recreation, their appreciation for the natural environment increases. Therefore, the Mt. Hood National Forest is actually protecting that habitat over time.

By focusing on key fish and wildlife species, sensitive habitats, and people's critical habitat needs, trail systems can be located, designed, and managed to meet the critical needs of wildlife and fish, while also providing opportunities for superior trail recreation experiences. The key is to fully examine fish, wildlife, and people's needs, then make informed management decisions recognizing the consequences of those choices.

The purpose of this report is to describe the key fish and wildlife species and sensitive habitats on the Mt. Hood National Forest; describe trail planning guidelines that address the key species, sensitive habitats and recreationists needs; and identify monitoring techniques to test assumptions and effectiveness of the guidelines.

This report is divided into seven parts: (I) Introduction; (II) Literature Review; (III) Methodology; (IV) Monitoring; (V) Future Research Needs; (VI) Summary; and (VII) Literature Cited.

A. Project Goal

The goal of this project is to fully integrate into trail planning, the recreation and fish and wildlife resources on the Mt. Hood National Forest.

B. Project Objectives

The objectives of this project are to:

1. Identify key fish and wildlife species, and sensitive habitats on the Mt. Hood National Forest.
2. Develop trail planning guidelines that address critical needs of key fish and wildlife species, sensitive habitats and trail users.
3. Develop trail planning guidelines that emphasize trail-users' needs, positive fish and wildlife interactions with trail users, and interpretive opportunities.
4. Identify monitoring procedures to validate assumptions concerning wildlife, fish and recreationists needs, and test the effectiveness of trail planning guidelines.

C. Project Scope

The Mt. Hood National Forest is an Urban Forest with a wide variety of users and expectations, often resulting in user conflicts. User conflicts are often rooted in differing expectations and individual value systems. This project will not address user conflicts. It will focus on the more objective nature of wildlife/trail interactions. In addition, since the Mt. Hood National Forest is dominated by forested ecosystems, this project will focus on forested fish and wildlife/trail interactions.

D. Background

In 1988, a process was developed in Washington State to evaluate interactions between O.R.V.'s, pedestrian, and equestrian back country recreation use. This process applied to forested environments across the Washington State. As part of the project, a comprehensive literature search was conducted and process developed. This project builds on the information developed in Washington and applies the principles of that evaluation process to the smaller geographic area of the Mt. Hood National Forest.

II. LITERATURE REVIEW

The first step in developing trail planning guidelines is to examine the current knowledge of trail interactions with fish and wildlife through a literature review.

This literature review utilized three detailed literature searches and reviews as a foundation for identifying current information. The Fox et al. (1983) review searched over 300 sources on the effects of O.R.V. use on wildlife in Washington State. Also in 1983, Raedeke et al. conducted a literature review of 148 sources on interactions between snowmobiles and wildlife in Washington State. The Sachet (1988) review searched an additional 75 sources to build upon the Fox et al. (1983) report to include the effects of pedestrian and equestrian back-country recreation interactions with wildlife. This review further expands the review topics to include dispersed winter recreation use and people's habitat needs. FS INFO NW services were utilized to search an additional 100 sources. Studies pertaining to the desert southwest and desert, or coastal beach ecosystems were not considered applicable to this project. The studies and literature reviews pertaining to Washington State were considered to apply to Oregon as well, since the ecology and geography are essentially the same.

Fox et al. (1983) concluded there were no scientific studies that quantitatively documented the effects of O.R.V.'s on wildlife in Washington State, particularly the heavily forested western portion. In addition, Fox et al. (1983) found that the many site-specific, management-related reports suggesting adverse effects were consistently based on judgments about habitat deterioration or on information extrapolated from studies done elsewhere. The same was found to be true in 1988 by Sachet, and again during this literature review.

Effects on wildlife by pedestrians, O.R.V.'s (including snowmobiles), mountain bicycles, and equestrians can be categorized in two ways: indirect and direct. Indirect effects are related to habitat disturbance; direct effects are disturbances to the animals themselves that cause a change in their normal activity.

Indirect effects of O.R.V., pedestrian, and equestrian use on soils and vegetation (the basis of wildlife habitat) have been documented. Trail use by hikers, horses, and motorcycles has been shown to increase bare ground area, trail width, trail depth, and soil bulk density (Dale and Weaver, 1974; Weaver and Dale, 1978). Numerous studies in high-elevation, forested, backcountry sites have shown that hiker, camper and equestrian use reduce trailside vegetative cover, cause tree damage, increase site size, and increase bare ground area (Merriam et al., 1973; Combs, 1976; Brown et al., 1977; Legg and Schneider, 1977). Other studies have documented an increased percentage of bare ground and exposed bed rock (Bogucki et al., 1975); an increase in the potential for soil erosion (Packer, 1953; Helgath, 1975; Bratton et al., 1977; Bratton et al., 1979); and reduction in soil organic matter (Dotzenko et al., 1967; Legg and Schneider, 1977). This reduction in site productivity results in less area for wildlife habitat production.

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Direct effects of O.R.V., pedestrian, and equestrian use on wildlife populations in the forested regions of Washington and Oregon is not well documented. One way to approach this lack of information is to examine related impacts and extrapolate the effects to trails. For example, the effects of forest roads and vehicle traffic is somewhat applicable to forest trails. As summarized by Fox et al. 1983, "O.R.V. activity disrupts the normal activity patterns of bighorn sheep (Jorgensen, 1974; Hamilton et al., 1982) and elk (Hoover, 1974). Vehicular traffic affects habitat selection as well as activity patterns in elk and deer (Rost and Bailey, 1974; Hershey and Legee, 1976; Perry and Overly, 1976; Ward et al., 1976; Lyon, 1979; Pederson, 1979). If mammals are harassed, Geist (1971) suggests they will learn to minimize encounters by reducing activities to areas, habitats, and time of day where encounters are minimal." Lyon (1979) suggests that vehicular traffic on forest roads may impact available elk habitat. One should use caution in comparing effects of forest roads to effects of forest trails, since forest trails normally exhibit narrower corridors, smaller cut and fill slopes, shorter sight distances, and denser trailside vegetation--all of which ameliorate the adverse effects of roads.

In two studies which compare the effects of snowmobiles and pedestrians on mule deer and white-tailed deer, Eckstein et al. (1979), and Freddy et al. (1986) report both species were more sensitive to pedestrians than snowmobiles. These reports reinforce the Fox et al. (1983) statement that animal reaction to people in or on vehicles, especially moving vehicles, is less pronounced than it is to humans without a vehicle (Hoover, 1974; Ward et al., 1976; Ward and Cupal, 1980; MacArther et al., 1982). In addition, Hammitt and Cole (1987) state that wildlife are often more readily disturbed by hikers than by motor vehicles. They further state that hikers are more unpredictable, more likely to approach animals, and may be considered more of a threat by animals. It is important to recognize however, that an O.R.V. encounter with an animal may be of shorter duration than a hiker or equestrian encounter. The potential for total encounters in a given period is greater with O.R.V.'s because of the greater speed and distance traveled (Fox et al., 1983).

Raedeke et al. (1983) reviewed the literature for interactions between snowmobilers and wildlife. The impacts researched included harassment, noise, winter energy conservation in deer and elk, hunting/fishing impacts, above-snow impacts, below-snow impacts, exhaust emissions, and mechanical damage to vegetation. Most of the investigations were conducted in the more heavily populated mid-west and eastern "snowbelt" states. Therefore, in many cases the direct application to the Mt. Hood National Forest is limited. There were some studies, however, that revealed important observations. In a 1980 heart-rate study by Ward and Cupal, elk reacted more strongly to humans on foot and stopped vehicles than to traffic on highways. Richens and Lauigne (1978) in Maine found white-tailed deer use snowmobile trails for travel and used the forage next to the trail. In another study, Dorrance et al. (1975) compared hunted and unhunted white-tailed deer population in Minnesota. Over a two-year period, the hunted deer were more reactive to snowmobiles than unhunted deer. This may be because the hunted deer were less habituated to snowmobiles and were more afraid of humans. Heavy snowmobile use produced more reaction than no use, but light use was about the same as heavy use. Day

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use produced more reaction than night use. Some of the hunted population left the area of use, while none of the unhunted population left (Dorrance et al., 1975).

Raedeke et al. (1983) also examined the below-snow impacts. The subnivean space is the area between the snow surface and ground surface (Raedeke et al., 1983). This is the winter habitat for small mammals that do not hibernate. The impact of snowmobiles and other over-snow vehicles is to compact the snow and reduce or eliminate the subnivean space, therefore lowering the carrying capacity of those wildlife species dependent on that winter habitat (Raedeke et al., 1983).

Damage to vegetation from over-snow vehicles may result in direct physical breakage. Breakage to woody vegetation may occur in young plantations where terminal leaders are above the snow surface, on steep slopes, and in areas with thin snow cover (Raedeke et al., 1983). Raedeke et al. (1983) and Keddy et al. (1979) found no significant effects from snowmobiles on marsh vegetation. This review also searched for interactions between mountain bicycling, and fish and wildlife, but found very little meaningful documentation. Hain (1986) stated that research concerning mountain-bike damage to resources has not been completed. He also suggests that soil erosion may be the greatest resource impact since mountain bikes traveling over the same trail, often follow the same line. This results in a trough which is very conducive to erosion.

In reviewing literature on trail users' needs, Clark (1988) suggests applying wildlife concepts to human recreation behavior and user needs. The following discussion summarizes Clark's (1988) recreation habitats as applied to trail users. *Travel Corridors* are definable, trails are influenced by physical-biological conditions such as topography and vegetation. Recreationists have a *home range* in which they normally travel to recreate, and often exhibit *territorial* behavior by forming strong attachments to favorite and frequently-visited sites. Recreational *browse* within the home range exists from combinations of settings, activities, and experience opportunities which satisfy the trail users' desires. The choices people make about how they use an area depend on the *site attributes*. These attributes often facilitate responsible or irresponsible trail and forest use. *Edges* are an important habitat component by providing variation in the forest landscape or setting. *Essential or critical habitats* exist in trail systems. For example, trailheads are critical for users to access a trail system. People generally like *diversity* in the trail setting, sites to visit, and length and difficulty of trail. And finally, *adaptation* occurs as recreation habitats change. Recreationists often change their use pattern as the trail setting changes. For example, if trail mileage is lost to new road construction, some trail users may stop using the trail and go elsewhere. Clark (1988) explains that "the recreation-habitat approach helps focus management on sites (present and potential) and helps evaluate how resource-management activities (as well as natural changes) will affect these sites and the choices recreationists make. It also treats recreation at the same level of resolution as other resources.

It is clear there is a lack of quantitative documentation of O.R.V., snowmobile, mountain bicycle, pedestrian, and equestrian interactions with wildlife and fish in the forested Pacific Northwest and in particular, the Mt. Hood National Forest. Until adequate re-

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search is conducted, the ability to manage motorized, mountain bike, equestrian, and pedestrian backcountry recreation in relation to definitive wildlife interactions is restricted to judgement, and may be controversial.

One way to reduce the potential controversy is to develop a set of trail-planning guidelines that address individual species and habitats.

III. METHODOLOGY

The methodology employed by this project utilizes a process developed by Beckstead (1987) and refined by Sachet (1988) in Washington State to evaluate wildlife interactions with O.R.V., pedestrian and equestrian backcountry recreation projects.

The Beckstead (1987) process followed the principles of feature-species management (Zeedyk, 1974). First, key species were identified which met one or more of the following criteria: (1) were potentially very sensitive to backcountry recreation use; (2) represented significant ecological or economic importance; (3) represented a unique, limited, or sensitive habitat. Next, sensitive habitats were identified which met one or more of the following criteria: (1) were ecologically unique; (2) were potentially very sensitive to backcountry recreation use; (3) provided essential habitat for a key species during a critical period of the species' life history. The third step of Beckstead's process was to develop mitigation measures to address the key species and sensitive habitats. Sachet (1988) applied and refined Beckstead's 1987 process. He identified key species and sensitive habitats, then developed project-planning recommendations to manage the potential impacts from pedestrian, equestrian and O.R.V. backcountry recreation interactions with wildlife on a State-wide basis. The emphasis of Beckstead's process was clearly on fish and wildlife needs.

This project methodology follows the same procedures as Beckstead (1987) and Sachet (1988) for key species and sensitive habitat identification. Then trail planning guidelines are developed to address the key species, sensitive habitats and users' needs. More emphasis is placed on meeting the recreational habitat needs (Clark 1988) of trail users in this project. In addition, this methodology addresses mountain bicycling and winter trail use, whereas the Beckstead process (1987) did not. This project applies only to the Mt. Hood National Forest, instead of the entire State of Washington.

This section is organized into three parts: (1) Key Species are identified; (2) Sensitive Habitats are identified; and (3) Trail Planning Guidelines are developed.

Key Species

As stated earlier, the potential interactions between forest trails and the following key species are a concern because of one or more of the following: (1) the species is potentially very sensitive to trail or associated recreation use; (2) the species represents significant ecological or economic importance; (3) the species represents a unique, limited or sensitive habitat.

The following discussion of each key species is organized into three parts: (1) the species' life requisites and habitat needs are briefly explained; (2) potential interactions with trail users are identified; and (3) the critical period for potential impacts is identified. Pertinent literature and personal communications were reviewed to discover this information. In

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each case, if documentable differences between recreation types (pedestrian, equestrian, O.R.V., mountain bike, cross-country ski or snowmobile) could not be distinguished in the literature, they are treated equally and referred to as human disturbance.

Peregrine Falcon

The American peregrine falcons generally prefers open country such as marshes, coastal and river shorelines, estuaries, wide meadows, farmlands, and prairies in interior areas which suit their style of hunting. Peregrines feed on a variety of songbirds, shorebirds and waterfowl. They capture their prey on the wing, diving from several hundred feet in the air at speeds up to 200 miles per hour. These birds may range ten miles or more while foraging. Peregrines usually nest on ledges or on cliff faces in undisturbed areas overlooking plains or bodies of water (Welty, 1975). They have also been known to nest on river banks, abandoned raptor nests (eyries), buildings, and bridge abutments. They do not build a nest, but instead form a shallow depression or scrape to lay their eggs (Sachet, 1988).

Peregrine falcons are particularly sensitive to disturbance near the nest cliff from April to June during the breeding, incubating, and early fledging season (Sachet, 1988). Human disturbance can cause abandonment of a nest site, abandonment of nests after egg laying, ejection of eggs from the nest, or premature fledging of the young. Disturbances by birdwatchers, hikers, low flying aircraft, overzealous photographers, blasting, shooting and road construction have caused interruption of the nest cycle and desertion of the clutch (Pacific Coast Recovery Plan for the American Peregrine Falcon, 1982).

Bald Eagle

The habitat needs of bald eagles vary with their activities and behaviors. Bald eagles may frequent different areas during the breeding season and winter. Bald Eagle nests are usually within two miles and most often within 0.5 miles of a body of water, such as a bay, river or lake. These environments provide the necessary food sources for rearing young. Bald eagles generally nest in trees large enough to support their heavy and bulky nests. They nest primarily in old-growth Douglas fir, or in the large horizontal branches of the dominant tree within a stand. The nests are placed near the tree top. They use the same nest repeatedly.

During the late fall and early winter, bald eagles frequent the shorelines of rivers, coasts, and streams, or wherever there are concentrations of waterfowl or sizeable fish runs. They also use areas away from water if there are other sources of available food, such as carrion or rabbits. Bald eagles roost communally during the winter, both day and night. Day roosts may be along the waterway where birds perch when not feeding. Night roosts tend to be away from the feeding areas in more protected sites further inland. Roost trees tend to be large, dominant trees with big branches. The protection from the elements that a night roost provides may be as important to the eagles survival as a good food source.

Night roosts protect the birds by helping them conserve energy which makes it easier for them to survive the winter.

Human disturbance can seriously impact both nesting and wintering bald eagle populations (Brown, 1985). Disturbing activities are most critical during egg-laying (March through mid-April), incubation (mid-April through mid-May) and fledging (mid-May to mid-August) stages of nesting (U.S. Fish and Wildlife Service Bald Eagle Management Guidelines, 1977; Brown, 1985; Pacific Bald Eagle Recovery Plan, 1986). Even temporary abandonment of a nest due to disturbance may result in chilling or overheating of, or predation on eggs or young (Stalmaster and others, 1985). During the early stages of fledging, human disturbance may cause young eagles to fall from nests or perches (Sachet, 1988). Documented types of disturbance to wintering eagles include those from motor boats, drift boats, fishermen on the shore and hikers. Some bald eagles appear to become conditioned to automobile traffic on and near roads (Pacific Bald Eagle Recovery Plan, 1986). Bald eagles also have a tendency to gorge themselves on carrion which results in a period when the eagle is unable to fly. Eagles may be particularly sensitive to human disturbance during the "non-flight" period after overeating, because they are unable to escape human intrusions (Otani, pers. comm. 1990).

Salmonid Fish

Salmonid fish of the Mt. Hood National Forest utilize a wide variety of lakes and streams ranging in size from headwater tributaries to the mainstream Columbia River. The preponderance of spawning and rearing by salmon, steelhead, and trout in forested watersheds takes place in second, third, and fourth order streams. Additionally, the quality of first order streams is vital to the quality of salmonid habitat downstream. The channels of these streams carry water, sediment, nutrients, and organic debris from upper portions of the watershed to larger tributaries downstream (Brown, 1985). For optimum production, all salmonid species require: cool, continuous flowing waters; free migration access to and from the sea (if anadromous); clean gravel substrate for reproduction; water of low-sediment content during the growing season (for sight feeding); high levels of dissolved oxygen content in streams, lakes and intragravel environment; sufficient instream cover; and invertebrate organisms for food (Brown, 1985).

Brown (1985) explains that the habitats along the edges and side channels of streams are critical for summer rearing and overwintering of juvenile fish. This rearing habitat provides cover and an aquatic insect food source.

The greatest potential impact from recreation trails on salmonid fish is degradation of spawning and rearing habitat. Degradation of spawning habitat would most likely occur from excessive sediment content in spawning gravel, and migration barriers to and from spawning areas. Incubating eggs require freely moving water in the spawning nest (redd) to supply high concentrations of dissolved oxygen and to remove metabolic waste. Fine sediment clogs the spaces between gravel which inhibits this free movement of water. In addition, sediment-clogged gravel can prevent newly hatched fry from emerging (Brown,

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1985). Degradation of rearing habitat would most likely occur from restricting the water flow in side channels or breaking down stream banks (Hohler, pers. comm. 1990).

Barriers to migration are another potential for spawning failure associated with recreation trail construction. Culverts with outfall barriers, excessive water velocities, insufficient flow, lack of resting or jump pools, or a combination of these factors can prevent spawning migration (Brown, 1985). Fords that do not allow up and downstream migration are another potential barrier.

The critical period for sediment transport, deposition, and barriers to migration will vary upon the species or combination of fish species inhabiting the stream.

Another potential impact directly related to recreation trails and associated access is overfishing. Small mountain streams often maintain inherently low populations of salmonid fish. Once access is provided, these areas can be overfished in a relatively short period by a small number of people. Once overfished, these streams recover very slowly, due to the low level of natural recruitment and reproduction (Sachet, 1988).

Spotted Owl

The spotted owl is a medium-sized, nocturnal bird that lives in the mountainous, forested regions of the West. The spotted owl shows strong preference for foraging, roosting, and nesting in old-growth stands, or in mixed stands of old-growth and mature coniferous forests. These forests contain the structural characteristics and type of vegetation that best provide spotted owls with food, cover, nest sites, and protection from weather and predation (Final Supplementary Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide, Spotted Owl Guidelines, 1988). Spotted owls have large home ranges, the sizes of which vary between summer and winter. Northern flying squirrels, and dusky-footed woodrats are the preferred prey. Voles, mice, gophers, birds, and other small mammals serve as additional food sources. Spotted owls hunt primarily at night, dropping from a perch onto their prey. Spotted owl nests are located in old-growth trees in cavities created by structural damage and decay, clumps of dwarf mistletoe infection, or in old stick platforms that were constructed by other bird or mammal species (Brown, 1985). Two to three eggs are laid and incubated by the female. The young hatch in April or May, (these dates may vary somewhat according to elevation and snow cover). Young then leave the nest when about 35 days old. The parents continue to feed them until late summer when the juveniles disperse. In addition to suitable nesting and foraging habitat, spotted owls need dense multilayered forests for roosting during the day. These owls regulate their body temperature by moving up and down in the forest canopy and from one aspect to another. Typically, during the summer, they can be found close to the ground on hot days, then move higher into the canopy at night. During the winter months, spotted owls will often utilize sunny, south aspects to stay warm (Sachet, 1988).

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The interactions between trails and associated recreation use, and spotted owls are not fully known. The F.S.E.I.S. Spotted Owl Guidelines (1988) state that recreation within the primitive and semi-primitive Recreation Opportunity Spectrum (R.O.S.) classes present the least conflict with management of spotted owl habitat. The F.S.E.I.S. also reports that most spotted owl survey responses occurred in primitive, semi-primitive, and roaded natural R.O.S. classes. The presence of a road or trail appears to be less significant than other habitat factors described above. The F.S.E.I.S. (1988) also suggests that camping in developed campgrounds and O.R.V. use could affect spotted owl habitat; however, it is not known if these types of recreation interfere with reproduction success and dispersal of young. The F.S.E.I.S. (1988) continues to suggest that since spotted owls are nocturnal foragers, many recreational activities may be compatible with spotted owls, even within their home range. The F.S.E.I.S. (1988) concludes with, "it is doubtful that presence of humans directly affects the viability of spotted owls." In a personal communication with Forsman (1988), he suggested that the nest area was the critical area for potentially negative interactions between owls and recreationists. He suggested that activities associated with trail construction and maintenance, such as blasting and chainsaw operation, may be disrupting and should be minimized during the nesting season.

Accipiter Hawks (Goshawk, Cooper's, Sharp-shinned)

Goshawk

The goshawk occurs in all elevations up to timberline and requires dense old-growth multiple-canopy conifer stands for nesting. The nest is a platform of sticks placed high in a large tree (18" diameter breast height (d.b.h.) or larger). The nest site is usually on a north slope and is near a water source. The goshawk needs fallen logs or stumps upslope from the nest for roosts and plucking sites. The goshawk preys mostly on birds and a few small mammals (West, 1976).

Cooper's Hawk

This hawk prefers dense deciduous or coniferous second growth forest stands within 1/4 mile of water. The nest site is a platform of sticks or an abandoned crow, hawk or squirrel nest. Nest sites are usually on a north slope. The Cooper's hawk needs fallen logs or stumps upslope from the nest as plucking sites. This hawk preys mostly on birds, a few rodents, reptiles, amphibians and insects (West, 1976).

Sharp-shinned Hawk.

The sharp-shinned hawk is found in dense pole/sapling deciduous or coniferous stands within 1/8 mile of water. The nest site is usually on a north-facing slope, and is composed of a platform of twigs in a tree or an abandoned crow, magpie or squirrel nest. Some taller snags are needed for perching. It forages wherever there is dense cover and an abundance of small birds. The sharp-shinned hawk also preys on rodents, frogs, lizards and insects (West, 1976).

All three of these hawks are sensitive to human intrusion into their nesting area, and are incredibly aggressive during their nesting season from March through June (Beebe, 1974). The aggressive reaction to intrusion causes the females to leave the nest, exposing eggs or young to predation and cooling, thereby reducing the chance of nesting success. Another potential threat is physical injury to the intruder from attacks by these hawks (Beebe, 1974). Reynolds et al. (1982) determined boundaries of nest sites by observing the movements of adults and fledged young as well as the location of prey plucking areas and roosts. Measured nest sites in Oregon ranged from approximately 4 ha (9.88 acres) for sharp-shinned hawks to 6 ha (14.82 acres) for Cooper's hawks, and from 8 ha to 10 (19.76 to 24.7 acres respectively) for goshawks. Hoover and Wills (1984) report goshawks defending an area up to 200 yards (approximately 10 ha) from the nest site.

Gray Wolf

The gray wolf is a social animal. It lives in packs of two to 15 animals formed primarily of family members and relatives (Whitney, 1942). Within the pack, there is a dominance hierarchy consisting of a dominant male and female, pups, and other adults. Wolves are more dependent on the availability of suitable prey than any specific type of habitat. They are found mostly in remote backcountry areas where the potential for human interaction is minimal. Sitings in the Mt. Hood National Forest have been limited to wilderness areas. Wolves spend most of their waking hours hunting. Their primary targets are large animals such as deer and elk. They also supplement their diets with smaller animals. They tend to prey on the most vulnerable individuals, such as the old, sick or young. Wolves mate for life. They do not make regular use of shelters. A den is constructed or occupied only for the birth and care of the young, approximately two months. Dens are usually located on slopes, ridges, or other high ground, and near a source of water. While the pups are young, the pack will restrict its normally wide-ranging hunting forays. Once the young are old enough, they travel with the pack.

The literature generally describes disturbances to wolves in terms of exploitation, habitat reduction and control. Historically, misunderstanding and fear of wolves has lead to extensive exploitation and attempts at control of the species. In fact, there are no documented cases of modern North Americans being seriously injured by wolves (Northern Rocky Mountain Wolf Recovery Plan, 1987).

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Habitat reduction refers to the increasing use of backcountry by humans. Wolves on Isle Royale have been reported to avoid recreation trails during the summer (Northern Rocky Mountain Wolf Recovery Plan, 1987). The Recovery Plan also states that fall and winter may be the critical survival periods for wolves due to malnutrition, disease, injuries, inter-pack strife, and human exploitation and/or control. Exploitation has not been specifically defined.

Habitat alteration associated with trails is another potentially negative interaction between trails and wolves. Habitat alteration results from increased human activity in an area. This can be the result of increased trail and road densities, campgrounds, trailheads, and numbers of people which may cause wolves to abandon an area. Habitat alteration often means less effective habitat (Sachet, 1988).

Elk and Deer

Roosevelt elk, back-tailed deer, Rocky Mountain elk, and mule deer are treated together as key species. Although Roosevelt elk and black-tailed deer are primarily westside Cascade species, and Rocky Mountain elk and mule deer eastside species, their primary habitat requirements are very similar. The significant habitat differences occur in special habitats such as calving and fawning areas, winter range, and migratory behavior. For example, black-tailed deer have a smaller home range and migrate elevationally versus mule deer which have a large home range and migrate east to west. It is generally recognized that, although there is variability in patterns of habitat use between species, as well as differences in physiology, size and behavior, meeting the habitat needs of elk will also provide for deer habitat (Brown, 1985).

Like other animals, the basic habitat requirements of deer and elk are space, water, food and cover. Forage and cover are the main habitat components; their distribution in time and space are the primary factors that limit deer and elk populations (Brown, 1985). Grasses and shrubs are important forage for deer and elk. Forage areas defined by Brown (1985) are vegetated areas with less than 60 percent combined canopy closure of trees and tall shrubs (greater than seven feet tall). This includes the grass/forb, shrub and open sapling/pole stand conditions, and may include some older, thinned stands. In managed forests, primary forage areas are those that have had all or most of the forest canopy removed.

Cover is separated into hiding and thermal components. Hiding cover is defined as any vegetation capable of hiding 90 percent of a standing adult deer or elk at 200 feet or less (Thomas, 1979). This includes some shrub stands and all forested stand conditions with adequate tree stem density or shrub layer to hide animals. In some cases, topographic features can also provide hiding cover (Brown, 1985). Hiding cover provides security from predators and human disturbances, which allows the animals more time to forage and rest. Thermal cover is defined by Brown (1985) as a forest stand that is at least 40 feet in height with tree canopy cover of at least 70 percent. These conditions are achieved in closed sapling/pole stands and by all older stands unless the canopy cover is reduced

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below 70 percent. Thermal cover is used during the summer and winter to reduce energy expenditures.

Brown (1985), further defines optimal thermal cover as a forest stand with: (1) four canopy layers (overstory, sub-canopy, shrub layer, and herbaceous layer); and (2) an over-story canopy which can intercept and hold a substantial amount of snow, yet has dispersed, small (1/8 acre) openings. These criteria are generally achieved when the dominant trees average 21 d.b.h. or greater, have 70 percent or greater crown closure, and are in the large sawtimber or old-growth stand condition. In addition to providing hiding and thermal cover, this habitat provides forage during periods of adverse weather, and intercepts a significant amount of snow.

The size and spatial arrangement of cover, forage, and open road density determine the effectiveness of these habitats. The optimum mix of cover to forage for elk is 40 percent cover (20 percent hiding, 20 percent thermal), and 60 percent forage area with not more than one mile of open road per square mile of land base (Thomas, 1979). Optimum size of stands for elk thermal cover on summer and spring/fall ranges is 30 to 60 acres; optimum forage sizes are 40 acres maximum (Thomas, 1979). In addition to forage and cover, deer and elk require water on a daily basis, the source being within 0.5 mile of any point (Thomas, 1979).

The greatest potential for negative interactions to occur between recreation trails, elk, and deer appears to be associated with winter range, and elk calving and deer fawning periods (Brown, 1985).

Thomas and Toweill (1982) explain the potential effects of human disturbance on wintering deer and elk: "During winter, animals already face the combined stress of snow, cold weather, limited food supply, and pregnancy. With these conditions, even minor disturbances are likely to have serious effects on survival and reproductive performance." The excitement resulting from motorized or non-motorized interactions causes energy expenditure which may jeopardize winter survival or growth of the fawn or calf the female is carrying (Thomas and Toweill, 1982). On the average, the critical period for elk and deer on the east side of the Forest is December through March. In addition, the vegetative "green-up" period in the early spring is a very important time to minimize disturbance. Deer and elk are coming out of a long winter period, their diet is changing and females are carrying calves and fawns. During this period, they are very vulnerable to any additional stress (Sachet, 1988).

On the west side of the Forest, the critical period is December through March. Human disturbance can be a bigger factor on the westside because trail associated recreation is not hindered as much by snow and cold weather.

Larch Mountain Salamander

The Larch Mountain salamander occurs in the lower Columbia River Gorge. Known sightings are limited to an area between Bridal Veil at the west end of the Gorge to Hood River on the east end, and south to Larch Mountain (Kirk, 1983). The Larch Mountain salamander is limited in habitat to areas of relatively small-sized, angular lava talus (Kirk, 1983). Preferred habitat includes overstory closure of greater than 75 percent, ground cover less than 25 percent, and soil content less than 25 percent (Hallett, 1989). This salamander appears to move vertically in talus in response to moisture and temperature. During wet weather it can be found near the surface. Then it moves to depths of eight to ten feet during dry or cold weather (Hallett, 1989). The Larch Mountain salamander is not known to defend a territory, and information on home range is not available (Hallett, 1989). This salamander is described as a "sit and wait predator" (Kirk, 1983) that feeds at or near the ground surface on mites and other invertebrates such as earthworms and snails (Hallett, 1989).

The primary disturbance factors to the Larch Mountain salamander include any activities that cause a shift in the talus slope (Hallett, 1989) or any activities that change the moisture/temperature regime of talus slopes. These disturbance factors are significant throughout the year.

Greater Sandhill Crane

Sandhill Cranes are omnivorous birds that are opportunistic in their feeding habits. These cranes feed on small reptiles, amphibians, rodents, grains, berries, roots, and insects found in wetlands, woodlands, sagebrush, and croplands (Hobson, 1989). Key habitat for nesting includes undisturbed willow-lined stream courses, wetlands, beaver dams and hummocks surrounded by dense brush. Sandhill cranes need shallow water for nesting and roosting. They build their nests on the ground during March and April, with peak breeding occurring in mid-April. Once the young hatch, they grow rapidly and are able to fly in two to three months (Hobson, 1989).

The nesting and early rearing period are the critical times for human disturbance to Sandhill cranes. They vigorously defend themselves, their nests, and young in their one-half to one mile radius nesting territory (Hobson, 1989). Adults defending their territory from disturbance leave the nest open to exposure of the eggs, or predation on the eggs or young.

Wolverine

The wolverine is a highly secretive, medium sized (24-40 lbs.) carnivore (Hall, 1981). The wolverine is a rare and year-long resident on the Mt. Hood National Forest that prefers mature forests in remote areas. It is confined mostly to alpine habitat above 6000

ft. elevation, which restricts it to primarily Wilderness (Hobson, 1989). The wolverine needs large tracts (20 square miles) of remote habitat with as little human activity as possible. The wolverine lives a scavenger lifestyle by following other carnivores and feeding primarily on carrion. Wolverines generally give birth in dens on the surface of the ground under snow.

The critical periods for wolverines are probably February and March when the young are born, and April and May when the young emerge from the dens (Hobson, 1989).

Western Gray Squirrel and Merriam's Turkey

These two species deserve comment, even though documented interactions with trail recreationists doesn't appear to exist. The western gray squirrel, and Merriam's turkey are two important game species that inhabit the pine-oak plant association type on the eastern fringe of the Mt. Hood National Forest. The western gray squirrel requires large, old ponderosa pine and Oregon white oak for denning and roosting. The Merriam's turkey utilizes large, old ponderosa pine for roosting, and accumulations of slash or natural forest litter for nesting.

Sensitive Habitats

The potential interactions between recreation trail users and the following sensitive habitats are a concern because they exhibit one or more of the following qualities: (1) the habitats are ecologically unique; (2) they are potentially very sensitive to associated trail use; (3) they provide essential habitat for a key species during a critical period of the species' life history.

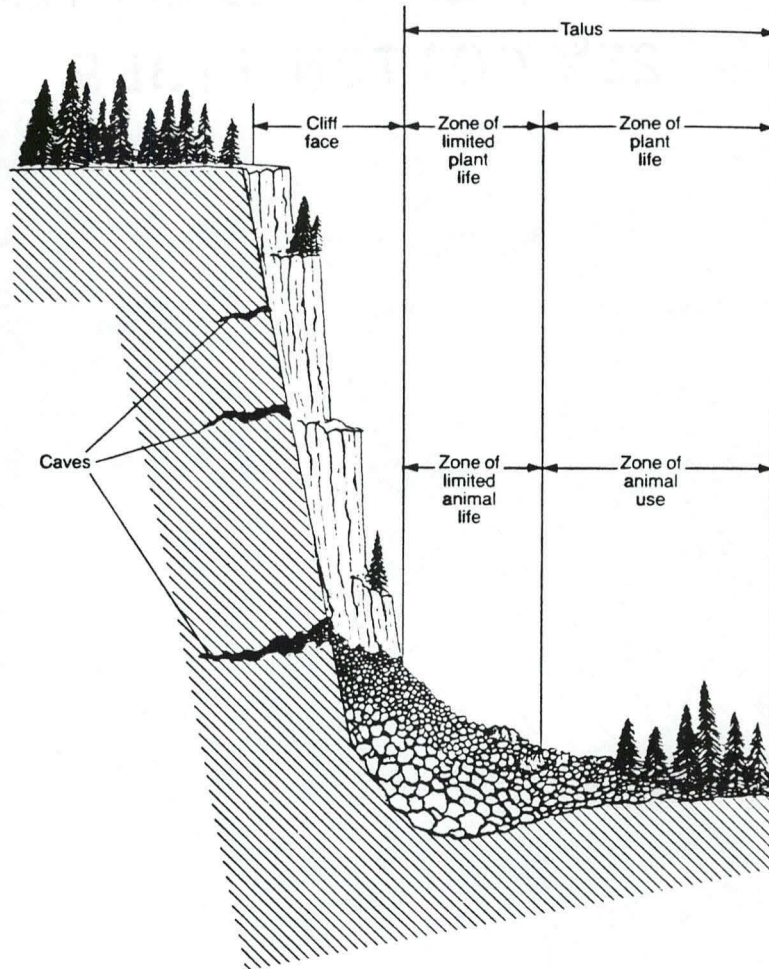
The following discussion of each sensitive habitat is organized into four parts: (1) the physical attributes of each habitat is briefly explained; (2) the importance of the habitat to wildlife, particularly key species is discussed; (3) the potential interactions with back-country recreationists are identified; and (4) the critical period for potential impacts is identified. Pertinent literature was reviewed to discover this information. In each case, if documentable differences between recreation types could not be distinguished, they are treated equally and referred to as human disturbance.

Cliffs, Talus, and Caves

Geologic features create habitats in which the primary functional elements are non-vegetative, as opposed to most forested wildlife habitats (Fig. 1). These unique habitats provide refuge for many wildlife species, some of which are so dependent upon these geomorphic features that they are not found elsewhere. Normally, cliff, rim, talus, and cave habitats are more resistant to change than plant communities; however, human activities may either directly alter these ecosystems, or reduce the effectiveness of the wildlife habitat (Brown, 1985).

Cliffs

A cliff or rim is a very steep, vertical, near-vertical or overhanging face of rock. Many animals utilize the features of cliffs and use the security found in cracks and ledges of the cliff face, to escape predators. Birds build their nests and small mammals make dens along rocky ledges. Many raptors, including the peregrine falcon, prefer cliffs for nesting and roosting. Often, the forested edge, adjacent to the top of a cliff, provides important travel or migratory routes for wildlife.



Talus

Talus is a sloping mass of dislodged rock fragments that accumulates on slopes

Figure 1

Cliffs, talus and caves.

or at the base of cliffs and rims. Talus provides habitat for a variety of reptiles, amphibians (including the Larch Mountain salamander), birds and mammals. Pika and marmots, which constitute part of the food base for raptors and other predators, are common mammals found in talus (Brown, 1985).

Caves

A cave is a natural underground chamber that is open to the surface. Caves provide shelter from extreme weather conditions, stable internal micro-climates for wildlife, and physical protection from predators. Shallower caves are used by deer mice, bushy-tailed woodrats, bats, and other small mammals which serve as the food base for raptors and other predators (Thomas, 1979). In addition, caves possess a delicate micro-environment due to the light wind currents and organic material inside (Brown, 1985).

Human disturbance to cliff, talus and cave habitats can have a serious impact on wildlife populations. Of particular concern are disturbances to cliffs that contain raptor nests (see Key Species descriptions for specific impacts and critical times). Recreation use on trails bisecting talus slopes can also disturb nesting raptors on adjacent cliffs. If the use on talus

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is too intense, foraging activities by predators may be interrupted. In the specific habitat of the Larch Mountain salamander, disruption of the surface drainage regime may negatively affect salamander populations. The micro-environment of caves can be easily altered by removal of vegetation, changes to the entrance, or by human intrusion (Brown, 1985). The critical period for disturbance will vary depending on the particular species and situation involved.

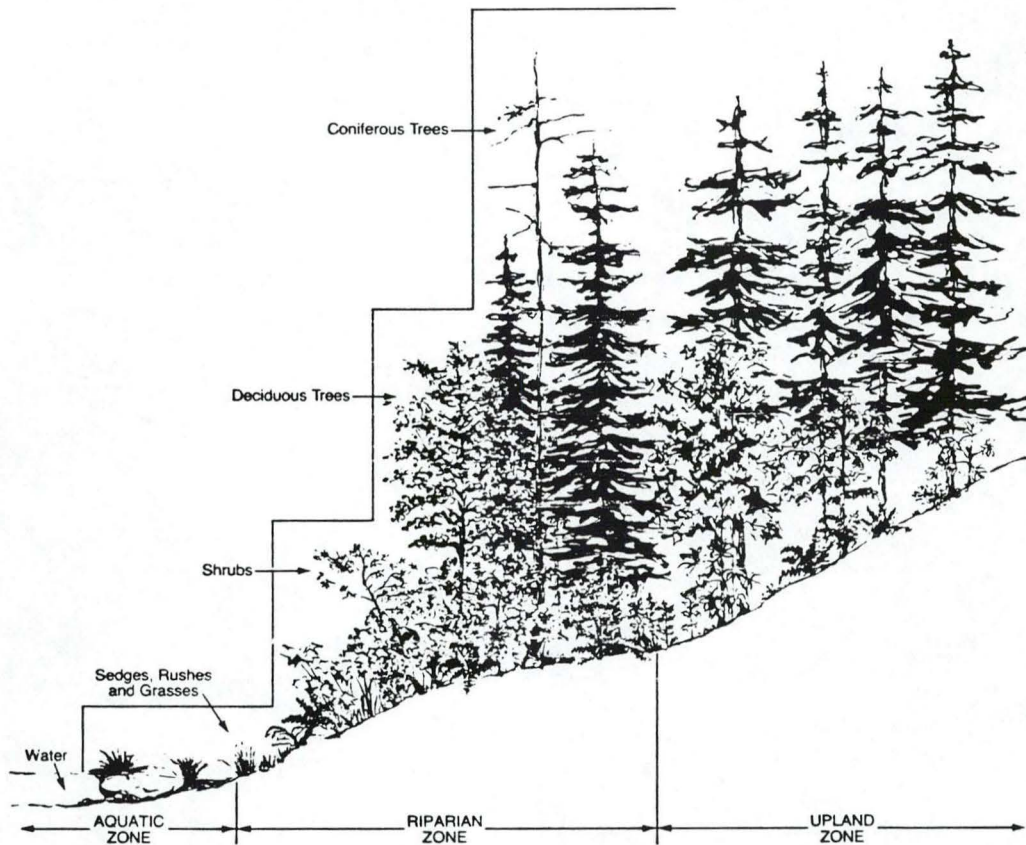


Figure 2

Riparian zones have varied vegetation.

Riparian Zones

Riparian zones are among the most heavily used wildlife and people habitats occurring on the Mt. Hood National Forest. The riparian zone or habitat is the area that lies between the aquatic and terrestrial ecosystems (Fig. 2). These zones can be identified by the presence of vegetation that requires free or unbound water, or conditions more moist than normal (Thomas, 1979; Brown, 1985). Riparian zones occur along rivers, streams, intermittent drainages, ponds, lakes, reservoirs, springs, and wetlands (wetlands will be treated separately). There is great variability in both size and vegetative complexity of riparian zones because variety of combination between the physical and biological characteristics. These characteristics include stream gradient, elevation, soil, aspect, topography, water quantity and quality, type of stream bottom, and plant community (Thomas, 1979; Brown, 1985).

Wildlife use riparian areas disproportionately more than any other type of habitat (Thomas, 1979; Riparian Habitat Technical Committee, 1985). Thomas (1979), attributes the critical importance of riparian zones to wildlife for a variety of reasons:

- The presence of water increases the importance of the zone. Wildlife habitat is composed of cover, food, and water. These zones offer one of these essential components, and often all three in close proximity.
- The greater availability of water to plants, often in combination with deeper soils, increases plant biomass production. This leads to increased diversity of plant species and structural diversity in plant communities.
- Structural diversity of the ecosystem is increased due to the contrast in plant communities between the riparian area and adjacent upland forest.
- The linear shape of streams and associated riparian areas maximize the productive habitat edges.
- Riparian zones in coniferous forests often produce a high edge-to-area ratio. The stairstep development of contrasting vegetation, i.e. deciduous versus coniferous, and shrubs versus trees, provides diverse nesting and feeding opportunities for wildlife (Fig. 3).

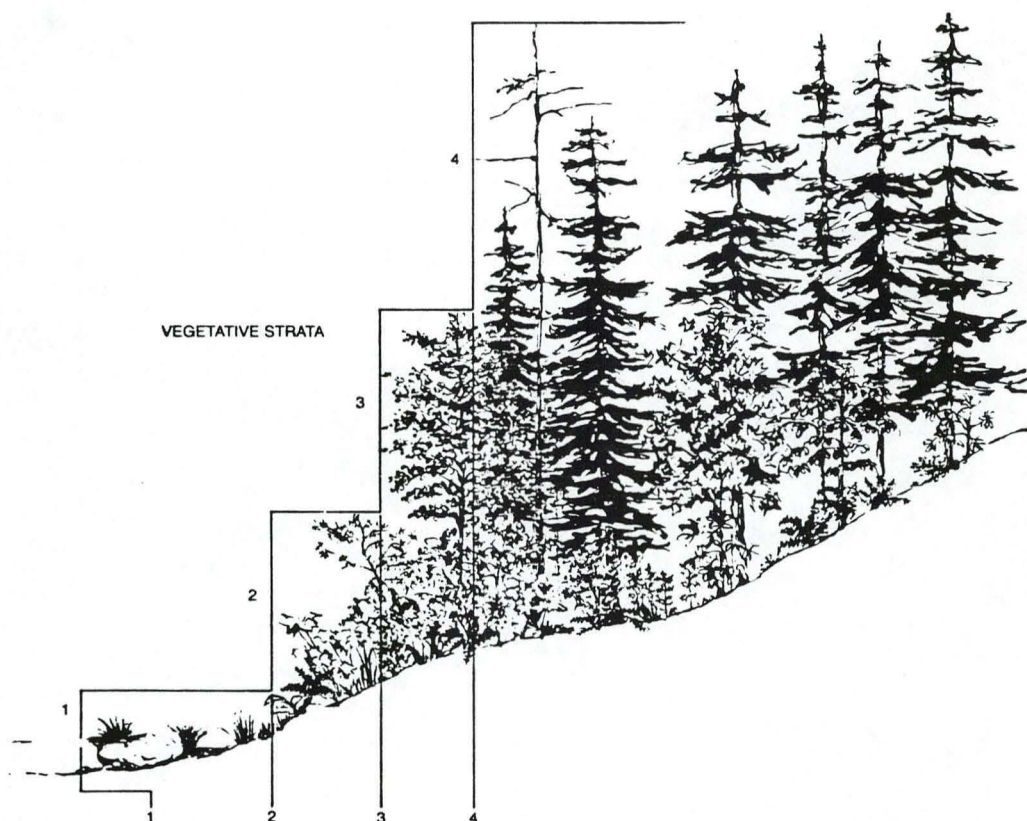


Figure 3

Vegetative strata in riparian zone.

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- The microclimate of riparian zones is different from the surrounding coniferous forests. Due to increased humidity, higher rates of transpiration, more shade, increased air movement, and topographic position, the temperature variations are less than adjacent upland coniferous forests.
- Riparian areas along permanent and intermittent rivers and streams provide important migration, travel, and dispersal routes for wildlife. These migration routes are of particular importance to deer and elk traveling from high elevation summer range to lower elevation winter range.
- Riparian zones along rivers and streams often provide vegetative connectors between forest habitats. Wildlife may use these riparian areas to travel between forested and unforested areas. These riparian zones are particularly important to small mammals and birds for dispersal from their original habitat to new territories.

Brown (1985) and the Riparian Habitat Technical Committee (1985) describe the habitat functions that attract wildlife to riparian areas as:

- **Forage and Water:** Riparian zones provide an abundance and variety of food for wildlife because of the diversity in vegetation. The free water that is commonly available is critically important to many species of wildlife. The vegetative and aquatic components of riparian areas support an essential prey base for the accipiter hawks, the bald eagle, spotted owl, peregrine falcon, and gray wolf. Forage is also supplied for elk and deer. Riparian vegetation provides habitat for insects and a source of organic matter for aquatic insects which form the food supply of salmonid fishes.
- **Breeding and Rearing:** The diversity of a riparian area provides a wide variety of habitats where wildlife can breed and rear young. Fawning and calving often occur in riparian areas where high quality food, water, and cover are nearby. Riparian areas not only provide nesting and rearing habitat for a variety of raptors and other predators, but these areas also provide nesting and rearing habitat for prey species. Riparian vegetation helps maintain quality fish spawning grounds by filtering sediments from surface runoff.
- **Hiding and Resting:** The dense vegetation, complex landforms, and abundant water found in riparian zones provide an essential hiding, and resting element for many wildlife species. Perch sites are provided for bald eagles and other raptors. The dense vegetation provides protected travel corridors for large mammals and other predators. Riparian zones provide areas of seclusion for feeding, resting, breeding, rearing, hiding, and brooding. Vegetation overhanging the water provides hiding cover for salmonid fish.
- **Thermal Cover:** Riparian vegetation provides thermal cover by ameliorating extremes in air temperature. Because of the location, topography, presence of water, and the amount and diversity of vegetation, these areas are often cooler in the summer and warmer in the winter. Many species of wildlife seek these areas to reduce stress from the extreme temperature of summer and winter. Riparian

vegetation helps maintain cooler water temperatures necessary for high quality salmonid fish habitat. Snow depths during harsh winters are often shallower in the riparian zone than in adjacent upland areas, which allow large mammals such as deer and elk mobility.

Wetlands

In the wetland environment, water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on the soil. Wetland habitats include marshes, swamps, bogs, seeps, wet meadows, and shallow ponds (Brown, 1985). Wetlands can also be defined as transitional lands between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands have one or more of the following characteristics:

- At least periodically, the land supports predominately hydrophytic (water-loving) vegetation.
- The substrate is predominately undrained hydric (saturated) soil.
- The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season each year (Cowardin, 1979).

Wetlands have enormous value to wildlife and are often associated with riparian zones. All of the characteristics, attributes and values to wildlife and fish discussed in the preceding Riparian section also apply to wetlands. Wetlands also have a stabilizing effect on watersheds which in turn benefit wildlife habitat. Wetlands absorb and store flood waters and spring runoff, allowing a gradual, constant and less damaging flow into the aquatic system. Wetlands also serve as "living" filters that screen sediments, pollutants and debris from water before it enters streams, lakes or the water table (Hoover and Wills, 1984). In addition, wetlands often serve as salmonid fish rearing habitat.

The potential for human disturbance to wetlands is the same as riparian zones and for the same reasons. The factors determining the potential impact and timing are the same as for riparian zones. As with riparian areas, wetlands need to be evaluated as an ecosystem.

Meadows

Meadows can be of two types: wet meadows, which can be considered wetlands, and dry meadows. Grasses, forbs, sedges, rushes, shrubs and scattered trees typify the vegetation of these meadows. The size varies from less than an acre to many acres depending on the physical characteristics of the site. One inherent characteristic is that the soil is either too shallow and rocky, or too wet to allow extensive establishment of conifers.

Although wet meadows are considered to be wetlands, both types of meadows serve important wildlife functions. The inherent edges formed around meadows, as with wetlands and riparian zones, are especially high in habitat richness. Meadows are important to deer

and elk because they provide nutritious forage species that rarely grow in the coniferous forests and they provide an inherent edge that enhances deer and elk use (Brown, 1985). Elk and deer depend heavily on meadows for foraging (Hoover and Wills, 1984). Wet meadows provide wallows for elk, and are extensively used as centers for harem collection and rutting activities (Brown, 1985). Meadows are also habitats for a variety of birds, rodents, and other small mammals which serve as prey species for larger predators.

As with riparian zones and wetlands, meadows are sensitive to human disturbance for the same reasons, and should be evaluated in the same manner.

Salmonid Fish Spawning and Rearing Areas

Resident and
anadromous
salmonids
select spawn-
ing sites on
gravel or cob-
ble riffles (Fig. 4).

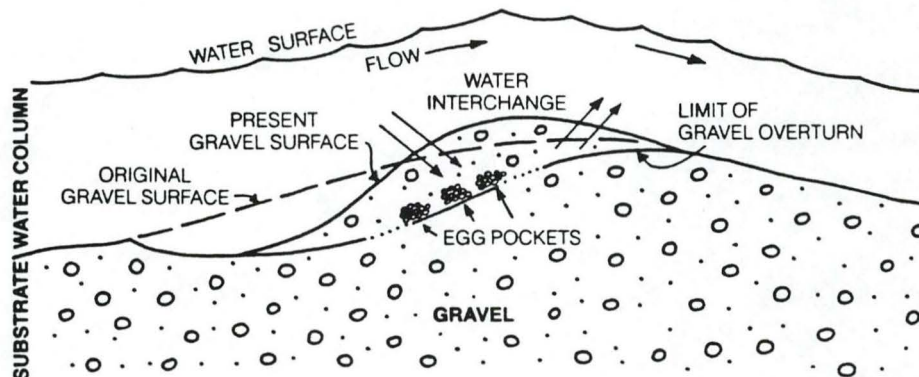


Figure 4 Salmonid eggs showing water interchange.

Resident salmonids generally select shallower, slower water, and smaller size gravel due to their smaller body size (Brown, 1985). Assuming the water depth, velocity, and cover requirements are met, successful spawning depends on an adequate supply of gravel or cobble and low sediment content. Adequate substrate supply is usually not a limiting factor and generally not affected by trail activities. Sediment content is the primary concern in maintaining high quality spawning habitat.

Incubating eggs require freely moving water in the spawning nest (redd) to supply high concentrations of dissolved oxygen and to remove metabolic wastes. Fine sediments clog the spaces between gravel and inhibit free movement of water. In addition, sediment-clogged gravel can prevent newly hatched fry from emerging (Brown, 1985).

The primary sources of sediment from recreation trail projects are the result of facility construction and maintenance. The greatest potential for sediment production occurs as a result of trail construction. Specifically, sediment sources from trail construction include sidecast material, mass wasting from unstable slopes, surface erosion, and excavation for culvert, ford, and bridge installations. These are impacts that normally can be avoided during facility location and design.

Inadequate trail maintenance can also produce significant amounts of sediment. Poorly maintained cross drains and water bars can pond water, causing the drain to fail, releasing stored water and thereby eroding the trail surface. The ponded water can also saturate the trail subgrade, causing it to fail and deliver sediment into a stream.

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Barriers to migration may also contribute to spawning failure associated with recreation trail construction. Culverts with outfall barriers, excessive water velocities, insufficient flow, lack of resting or jump pools, or a combination of these factors can prevent spawning migration (Brown, 1985). Fords that do not allow upstream and downstream migration are another potential barrier.

Rearing habitat is also critical to successful reproduction (refer to salmonid fish key species discussion). Poorly constructed trails can block side channels or block fish movement through side channels, thereby degrading or destroying rearing habitats. In addition, it is also important to maintain the cover provided by overhanging streambanks.

Sediment production, rearing habitat degradation and barriers to migration present the greatest impact to salmonid spawning and rearing habitat from recreation trail construction and maintenance. The critical period for these impacts vary depending on the species or combination of fish species inhabiting the stream.

Old Growth

Old growth refers to an ecosystem type with various characteristics that differentiate it from managed and young unmanaged forest stands. Old-growth ecosystems provide unique habitats to a variety of wildlife species.

Old-growth forests can be defined in qualitative and quantitative terms. The Regional Guide for the Pacific Northwest Region (1984) and Interim Definitions for Old-Growth Douglas-Fir and Mixed-Conifer Forests in the Pacific Northwest and California (PNW-447, 1986) defines old growth quantitatively. Quantitative definitions change over time--therefore, this report defines the old-growth concept in qualitative terms.

Old-growth forests are characterized by the following qualitative key features (adapted from Franklin and others, 1981; Society of American Foresters, 1984):

- Large, live old-growth trees. Two or (commonly) more tree species with a wide range in tree sizes and ages, often including a long-lived dominant (e.g. Douglas-fir, ponderosa pine or western larch), and a shade-tolerant associate (e.g. western hemlock, western red cedar, or grand-fir).
- Deep, multilayered crown canopy with trees of several age and size classes, and a relatively high degree of decadence indicated by heart rot, mistletoe, dead or broken tops, moss, and lichens. The uneven, understory trees typically range in size and age from young saplings to large sawtimber.
- Significant coarse, woody component including large snags and large down logs, including rotting material.
- Large logs and organic debris in streams.

These features are intended to depict the structural character of old-growth forest ecosystem types. The actual species, sizes, and ages will vary on the inherent productivity of the site and eastside or westside Cascade location.

The wildlife habitats which old-growth forests provide are unique and interrelated (adapted from Thomas, 1979; Franklin and others, 1981; Harris, 1984; and Brown, 1985):

- A large old-growth Douglas-fir tree is individualistic and commonly has an irregularly arranged, large, coarse branch system, and often a long crown. This is ideal habitat for specialized vertebrates such as the red tree vole, northern spotted owl, flying squirrel, and goshawk, as well as nitrogen-fixing lichens.
- The flying squirrel, a primary prey of the spotted owl is strongly dependent on nitrogen-fixing lichens and below-ground fungi for forage.
- Large snags are valuable nesting, roosting and foraging habitat for a variety of vertebrates and invertebrates, and as a future source of down wood and soil nutrients.
- Logs on the forest floor are important habitats for small mammals, part of the spotted owl's prey base.
- Logs are critical to the maintenance of physical and biological stability in head-water streams and intermittent drainages. Debris dams create stepped stream profiles that dissipate energy otherwise used for transporting sediment, and lateral-cutting and down-cutting of stream channels. Stream channel stability and sediment trapping of organic debris maintains water quality essential for salmonid fish habitat. In addition, large organic debris provides cover, and a nitrogen source for the food chain of salmonid fishes.
- Old-growth forests larger than 30 acres with a crown closure greater than 70 percent provide optimum cover for elk and deer.
- Nitrogen-fixing lichens are important winter food for elk and deer.
- Bald eagles show a strong preference for large, dominant or co-dominant trees in old-growth for nesting.

Old-growth forest ecosystems provide a diverse mosaic of habitat types. When considered individually, none of the above characteristics are unique to old-growth forests. The old-growth ecosystem is unique in possessing all of these attributes, and probably many unknown others, simultaneously (Harris, 1984). Careful planning of recreation trails is essential to protect the integrity of these ecosystems.

Disturbance to the old-growth ecosystem from recreation trails and associated use has not specifically been documented in the literature reviewed, unless one considers forest fires. However, since old growth is such a high-profile public issue in all aspects of resource management, the effects of recreation trails should be evaluated during the project scoping. One approach to evaluating potential interactions is to examine the potential effects on particular species known to inhabit the area. For example, an old-growth system with

a bald eagle nest or heron rookery should be treated differently than a system without any Threatened, Endangered, or Key Species. In using this approach, caution must be exercised to not overlook the value of the system as a whole, or the value of old-growth in its own right (this logic should be applied to all sensitive habitats).

Elk Calving and Deer Fawning Areas

Successful reproduction is essential for continued growth or maintenance of elk and deer populations (Brown, 1985). Thomas (1979) describes optimum elk calving habitat as containing forage areas, hiding cover, and thermal cover within forest stands close to water (within 1000 ft.). This enables the cow to meet all of her life requirements while staying close to her calf. Elk calving usually occurs between mid-May and mid-June on spring/fall transitional range where slopes are gentle (Thomas and Toweill, 1982); Brown (1985) adds, "warm areas relatively free of slash" to this description. Often, calving areas are located on gentle benches in steep topography (Thomas 1979). Cows may select a favorable micro-climate consisting of warm, southerly exposures with hiding cover (Sachet, 1988). Often, these areas are located in tree plantations that are old enough to provide hiding cover, but open enough to allow sunlight to reach the ground.

Thomas (1979) describes optimal deer fawning habitat as areas with low shrubs or small trees from two to six feet tall under a tree overstory of approximately 50 percent crown closure. This habitat tends to be in small areas (one to five acres) located on gentle (less than 15 percent), warm slopes with water within 600 feet. Mule deer fawning usual occurs from June to July, and black-tailed deer fawning from May to June (Schmidt and Gilbert, 1978).

Kneeland (pers. comm., 1990) suggests considering the importance of rearing habitat in addition to calving and fawning habitat. Brown (1985) supports this suggestion by stating "rearing habitat is extremely critical for most species." Rearing habitat is the combination of calving and fawning habitat, and nearby forage and cover in which the young are raised (Brown, 1985).

Thomas (1979) emphasizes the need to examine potential calving and fawning habitat to determine if use is actually occurring. In addition, the actual parturition or birth period varies across the Forest. Local verification of this period is also important.

Refer to the elk and deer key species discussion for the description of potential effects and critical periods for human disturbance during parturition.

Spotted Owl Habitat Areas (S.O.H.A.)

A Spotted Owl Habitat Area (S.O.H.A.) is a designated habitat area of 1500 acres. The goal of S.O.H.A.'s is to protect and manage old-growth/mature forest habitat for maintaining the continued existence of a viable population of spotted owls on the Mt. Hood

National Forest (Proposed Land and Resource Management Plan, Mt. Hood National Forest, 1988). S.O.H.A.'s on the Mt. Hood National Forest are dispersed throughout the Forest on a "grid" network. Each area is located below 4000 foot elevation, contains 1500 acres of suitable habitat, and is 1.5 miles from the next S.O.H.A. Each area will be managed under the Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide (1988) and the Mt. Hood Forest Plan. Refer to the spotted owl discussion in the Key Species section of this document for a description of suitable habitat.

Potential interactions with associated recreation trail use and critical periods for the spotted owl are discussed in the Key Species section.

Elk and Deer Winter Range

Elk and deer winter range varies between the east and west sides of the Mt. Hood National Forest. Winter range has been categorized on the Mt. Hood National Forest as either normal winter or severe winter range, with normal winter range defined as the land area used by animals during mild winters that occur eight to nine years out of every ten. Severe winter range is the area used by animals during severe winter conditions that occur one to two years out of every ten, or areas that the animals use during severe cold or snow conditions, even if that occurs on an annual basis (Otani pers. comm., 1990).

On the west side of the Cascades, severe winter range generally lies below 2,200 feet in elevation on all aspects, and includes wet areas above that elevation with special winter range qualities (Otani pers. comm., 1990).

Normal winter range includes land below 2,800 feet on warm aspects, the severe winter range, and any wet areas outside the elevational limits with special qualities (Otani pers. comm., 1990).

West-side winter range is based primarily on an elevational delineation, with some modifications reflecting field observations and telemetry studies (Otani pers. comm., 1990). Field studies indicate that wet areas with the following characteristics are special winter range sites:

- Surface water in small contiguous areas.
- Gentle slope gradients.
- Thermal cover in association with wet areas.

On the east side of the Cascades, severe winter range generally lies below 2,600 feet in elevation on all aspects (Otani pers. comm., 1990).

Normal winter range on the east side of the Cascades is based on actual use and field observations. East-side normal winter range includes the severe winter range (Otani pers. comm., 1990).

Refer to the elk and deer discussion in the Key Species section of this document for the description of potential effects and critical periods for human interactions with wintering deer and elk.

Pileated Woodpecker and Pine Marten Areas

Pileated woodpecker and pine marten habitat areas are designated areas of 600 acres for pileated woodpeckers, and 320 acres for pine martens. Often, these areas are combined into one unit. The goal of woodpecker and marten areas is to manage mature or old-growth forest habitat of sufficient quality, quantity and distribution to sustain reproductive pairs of pileated woodpeckers and pine martens (Proposed Land and Resource Management Plan, Mt. Hood National Forest, 1988). These areas are dispersed throughout the Forest on a grid network. Woodpecker areas are generally five miles apart, and marten areas are about two miles apart, center to center. The primary objective of these areas is to provide a high number of nesting and denning snags for the pileated woodpecker and pine marten respectively, and a high degree of dead and down material.

Documented evidence of human disturbance to these species is not apparent. However, the pileated woodpecker and pine marten are management indicator species on the Mt. Hood National Forest. By providing for the habitat needs of these species, many other species habitat needs will also be accounted for. Therefore, it is prudent to consider these species and associated habitat.

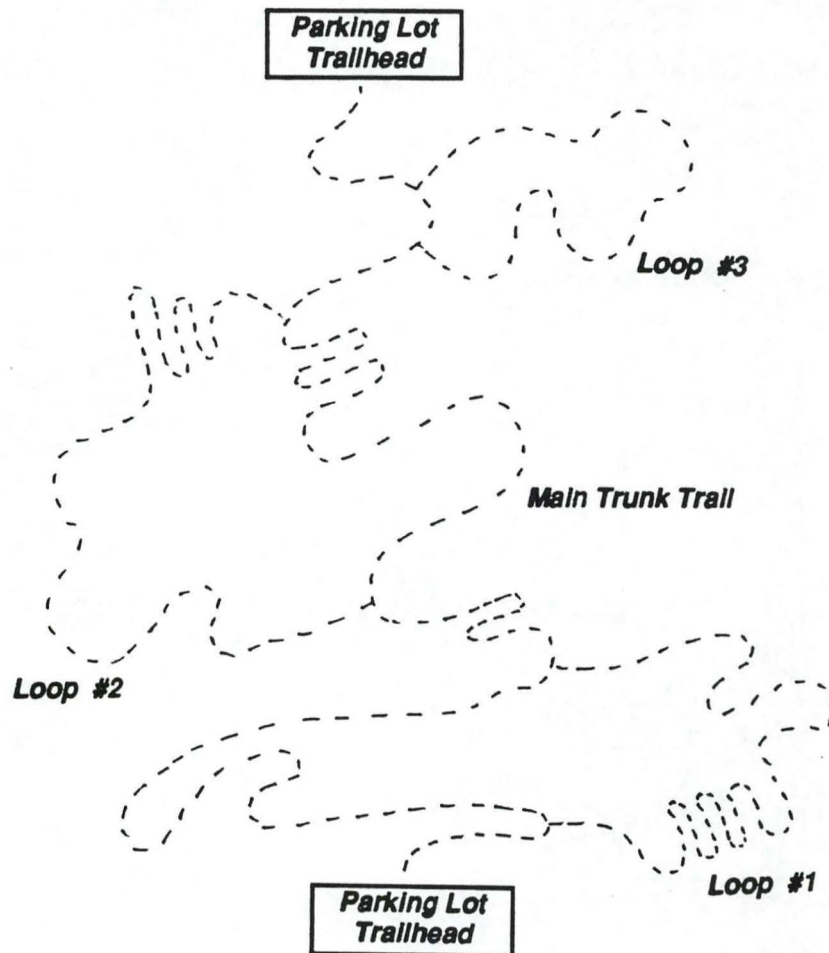
Recreation Trail Settings

In the Literature Review section of this document, Clark's (1988) concept of "recreation habitats" was introduced. In a general way, wildlife habitat concepts were related to recreation settings. This discussion will consider the relationship between the previously described sensitive wildlife habitats, and their value as recreation habitats. Each of the sensitive habitats discussed were a concern because the habitat is ecologically unique, potentially sensitive to associated trail use, or provides essential habitat for a key species. These wildlife and fish habitats are also sensitive people or recreationist habitats for the same reasons. Each habitat or combination of habitats, provides a unique recreational setting. Each wildlife habitat possesses characteristics of home ranges, travel corridors, territories, browse, site attributes, cover, edges, diversity, site preferences, and adaptations (Clark, 1988) that people seek also.

The following section on Trail Planning Guidelines will consider the inseparable relationship between protecting fish and wildlife habitat and meeting users' needs.

Trail Planning Guidelines

This section identifies trail planning guidelines designed to provide high quality trail settings for recreationists, and manage the potential impacts to key fish and wildlife species and sensitive habitats. To some people, these two objectives may seem mutually exclusive; however, this project suggests the opposite. To manage potential impacts to key fish and wildlife species and sensitive habitats, managed trail systems must be developed. In addition, these trail systems must be designed, located maintained, and managed to meet the recreationists' needs. Trail settings which meets the recreationists' needs will likely encourage the trail user to stay on the trail to achieve the desired experience. The result is a satisfied customer, less likely to venture off the trail, and a significantly decreased potential for negative fish and wildlife interactions.



Recreation Trail Planning Guidelines

Figure 5

"Loop" Trail system.

The following trail planning guidelines are designed to provide a recreational setting in which trail users can fulfill their individual habitat needs on the trail.

- Involve trail users to examine user demand and the need for different types of trails, and defining the desired future condition of the trail system.
- Involve trail users in the initial project scoping, field reconnaissance, trail location, layout, and design. Trail-user involvement in project planning insures that users' habitat needs have been identified and incorporated. For example, if the objective is to develop a motorcycle trail, invite local user groups to assist in the project planning. If the objective is to develop a winter cross-country ski trail and summer mountain bike trail, get both user groups involved in mutually meeting their needs.

- Design "Loop" trail systems (Fig. 6). A loop system (Wernex 1984) consists of a primary trail with other trails of varying difficulty diverging and returning to the main trail. A loop trail system provides management flexibility to address potential fish and wildlife interactions while meeting users' needs. For example, if a portion of a trail is located through a sensitive habitat and a seasonal restriction is recommended. Then, the manager can restrict use on a portion of the trail during the critical period, and leave the rest of the trail system open. This approach provides protection to the wildlife and fish, or sensitive habitat resource without limiting recreation use on the whole system.
- Provide a combination of trail systems available across elevations. For example, provide more than one low, medium, or high elevation system. This helps disperse use and provides a variety of trail settings.
- Design a trail system that challenges the recreationists both mentally and physically. By providing a variety of challenges, the trail user is most likely to stay on the trail, thereby reducing the potential for negative wildlife and fish interactions. Mental challenges might include solitude, or interpretive opportunities along the trail. Physical challenges might mean varying trail grades or exposure on an open slope.
- Provide vegetative and visual diversity on the trail. Locate the trail through different plant communities and age classes. Provide the opportunity for outstanding views of mountains, waterfalls or meadows. Provide side trails off the main trail to access unique features or provide opportunities to view wildlife. All of these actions facilitate the user staying on the trail to meet his or her needs.
- Adequate trail mileage is especially important for motorized trail users. Pugh (1989) suggests 30 miles or more of challenging trail conditions be provided. Wernex (1984) suggests a mixture of 10-15 miles of easy, 30-50 miles of moderate, and 10-15 miles of difficult trail in a loop system.
- A trail system should be entirely composed of trails. Avoid tying trails together with open road segments. In Oregon, motorized vehicles must be "street legal" to travel on open forest roads. Many models of trail bikes are not factory street legal in Oregon. By substituting open roads in a trail system it forces the motorized user to either break the law to use this open road link or double back onto the trail. Forcing a rider to double back on a trail invites boredom, and increases the probability that the rider will leave the trail to fulfill his or her experience.
- Provide support facilities such as trailheads, campgrounds, restrooms and visitor information boards as part of trail systems.
- At campgrounds designed for motorized trail systems, provide beginner trails, or a dedicated play area for children. This action entices children to stay in appropriate areas, thereby reducing the potential for unacceptable resource damage.

- Separate users whenever possible. Through the scoping process, identify which user groups are willing to recreate together or share trails. Then design the system to meet their needs.

Trail Planning Guidelines for Key Species and Sensitive Habitats

The following trail planning guidelines are designed to manage the potential impacts between trail users and Key Species and Sensitive Habitats. These guidelines are mitigation measures. The first priority in mitigation is to avoid through project design, identified negative impacts. If the interaction cannot be avoided, the next step is to minimize the interaction through restrictions. Finally, if the demand for a particular trail is great enough, and the impact on wildlife, fish, or sensitive habitats cannot be avoided, consider mitigation through habitat replacement. Habitat replacement should be considered only as a last resort and not considered for threatened and endangered species. Humans can rarely duplicate what nature has done naturally. Effective user information and education is essential throughout this process.

Key Species Trail Planning Guidelines

The following trail planning guidelines address the potential interactions and critical periods discussed in the Key Species section.

Peregrine Falcon

1. For known nest sites, follow the guidelines outlined in the Pacific Coast Recovery Plan for the American Peregrine Falcon, 1982.
 - 1.1 Prevent habitat disturbance and direct human interference at nest sites by locating trails and other associated facilities at least one-quarter mile from nests.
 - 1.2 Educate hikers, rock climbers, photographers, bird watchers, and other recreationists to avoid disturbing nesting peregrines.
2. If 1.1 is not possible, then restrict access during the critical period (April through June).

Bald Eagle

1. For known nest sites and winter habitat follow the Pacific Bald Eagle Recovery Plan, 1986 to minimize human disturbance at eagle use areas.
 - 1.1 Establish a one-quarter mile buffer zone around nest site until a site-specific management plan is developed. Human intrusion should be restricted within this zone during the critical period (March through mid-August), and permanent recreation facilities should not be constructed within this zone unless it is demonstrated that the eagles are compatible with human use.

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- 1.11 Where eagles have line-of-sight vision, human activity should be restricted within one-half mile from nest. Permanent recreation facilities should not be constructed within this zone.
- 1.12 Protect key wintering areas from human disturbance from mid-November through mid-March.
- 1.13 Trails and associated facilities should be designed to direct people away from eagle nest areas.

Salmonid Fish

- 1. For trail projects requiring work within the ordinary high water line of state waters, follow the standard procedures as specified in existing Memorandums of Understanding for a Section 404 Permit with the Corp of Engineers, and a Fill and Removal Permit with the State of Oregon.
- 2. Refer to the section on Salmonid Fish Spawning and Rearing Areas for more detailed guidelines on reduction of sedimentation and maintaining spawning migration access.

Spotted Owl

- 1. Avoid constructing trails or associated facilities within 660 feet of the nest area.
 - 1.1 If 1. is not possible, then seasonally restrict trail and associated use during the nesting season (March through June).
- 2. Avoid blasting and chain saw operations within 660 feet of nest during the nesting period (March through June).
- 3. Avoid locating trails through concentrations of standing dead and down material. These areas provide nesting and denning habitat for a variety of species which are often prey for spotted owls.

Accipiters

- 1. Inform trail recreationists of accipiter hawk's aggressive defense for their nest areas during nesting season.
- 2. Goshawks: Avoid locating trails or associated facilities within 600 feet of the nest site.
 - 2.1 If 2. is not possible, then restrict access within 600 feet of nest sites from March through June.
- 3. Cooper's Hawk: Avoid locating trails or associated facilities with 450 feet of the nest site.
 - 3.1 If 3. is not possible, then restrict access within 450 feet of nest sites from March through June.
- 4. Sharp-shinned Hawk: Avoid locating trails or associated facilities with 370 feet of the nest site.
 - 4.1 If 4. is not possible, then restrict access with 370 feet of the nest site from March through June.
- 5. Utilize loop trail systems to manage the nesting season restrictions.

Gray Wolf

1. Evaluate trail project objectives for consistency with the Northern Rocky Mountain Wolf Recovery Plan, 1987.
2. Only essential facilities should be developed at trail associated camp-grounds, and minimal public facilities should be provided at popular locations.
3. Trail associated campgrounds should be kept clean, free of food and refuse, and located away from prime wolf habitat.
4. Information should be distributed to the public about proper food and garbage storage and removal, and appropriate camping practices.
5. Provide information at trailheads identifying gray wolf habitat and recommending appropriate human conduct.

Elk and Deer

1. Avoid locating trails and associated facilities in known elk and deer winter range.
 - 1.1 If 1. is not possible, then restrict access during the critical period - December through March for east side and west side areas.
 - 1.2 Provide minimum-disturbance recreation travel corridors from low elevation areas to high elevations, thereby providing access to the higher snow zone for winter recreation.
2. Avoid locating trails and associated facilities in verified elk calving and deer fawning areas.
 - 2.1 If 1. is not possible, then restrict access during the critical period (elk: mid-May through mid-June; mule deer: June to July; and black-tailed deer: May to June).
 - 2.2 Utilize loop system trails for management flexibility. If the main trail must pass through calving or fawning areas, these trail segments can be seasonally restricted without significantly reducing the recreation experience, provided an alternate loop is available for use. Conversely, if a loop segment passes through calving or fawning habitat, access can be managed without restricting use on the entire trail system.
 - 2.3 Locate trails parallel to open roads (100-200) through elk calving and deer fawning areas.
3. Disguise game trails crossing recreation trails by using vegetative screening, or physically block game trails to prevent off-trail travel by recreationists, without precluding use by animals.
4. Utilize trailhead information signs to educate trail recreationists about:
 - Sensitivity of wintering animals to energy depletion during spring green-up period.
 - The need for animal seclusion while calving and fawning.
 - The need for recreationists to remain on trails during critical periods.
 - Reasons for seasonal restrictions on portions or all of trails.

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- Leaving pets at home.
- 5. Utilize news media to reach recreationists and explain rationale for restricting use. alternative areas and trail systems during sensitive periods for wildlife.

Larch Mountain Salamander

1. In known Larch Mountain salamander habitat areas, design trails to prevent shifting of talus slopes.
2. Locate or design trails to maintain existing temperature and moisture regimes in talus slopes.

Greater Sandhill Crane

1. Avoid locating trails within one mile of known Sandhill crane nest areas.
 - 1.1 If 1. is not possible, then restrict access within one mile of nest site from March through June.
 - 1.2 Utilize loop trail systems to manage restrictions and thereby reduce the impact on recreationists.
2. Develop side trails and screened wildlife viewing areas for recreationists to observe Sandhill cranes.

Wolverine

1. Keep trails and associated facilities to the minimum necessary to protect resources in Wilderness areas.
2. Utilize trailhead signs to inform recreationists of potential impacts to denning and newly born wolverine young from March through May.

Western Gray Squirrel and Merriam's Turkey

1. Avoid locating trails near gray squirrel denning habitat, and turkey nesting and roosting habitats.

Sensitive Habitat Trail Planning Guidelines

The following trail planning guidelines address the potential interactions and critical periods discussed in the Sensitive Habitat section.

Cliffs, Talus, and Caves

1. Refer to Key Species guidelines for peregrine falcon and Larch Mountain salamander for their relationship to cliffs, talus, and caves.

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2. In general, route trails away from cliffs, talus, and caves. When appropriate, locate trails with cliff access or through portions of talus slopes to provide the trail user with scenic views and setting diversity. Utilize these settings as interpretive opportunities to inform users of the unique wildlife habitat values, and sensitivity to disturbance.
3. Entrances to caves should be screened and/or avoided unless they are specifically developed for recreational and educational opportunities.
4. Evaluate rock and gravel borrow sites for wildlife habitat value before developing for trail construction.
5. Consider the interrelationship between cliffs, talus, and caves, and the adjacent vegetation.

Riparian Zones

1. Avoid locating trails and associated facilities in riparian areas.
 - 1.1 For trails and associated facility construction requiring work within the ordinary highwater line of state waters, obtain the appropriate Corp of Engineers and State of Oregon permits.
 - 1.11 Cross riparian zones in the shortest distance possible, at right angles to the drainage, and at designated crossings.
 - 1.12 Minimize disturbance to streambanks, streambeds, and other sediment-producing situations.
2. Determine the occurrence of key species, and other sensitive habitats; refer to the specific planning guidelines for each.
3. Provide the opportunity for recreationists to view significant natural features such as waterfalls and gorges.
4. Select access points to water and watering areas for recreational stock that will minimize site disturbance.
5. Select dispersed campsites in hardened areas outside the riparian zone and provide access to water.
6. Utilize visitor information boards to educate users about the sensitivity of riparian zones and their value to fish and wildlife.
7. Provide trailside interpretive opportunities to emphasize riparian values.

Wetlands

1. Avoid locating trails and associated facilities in wetlands.
 - 1.1 If wetlands are crossed, adhere to standards specified on Corp of Engineers and State of Oregon permits.
 - 1.2 If wetlands are crossed, use above-surface structures (e.g. boardwalks or bridges) to maintain water flow, and cross at the narrowest point.
2. Determine the occurrence of key species and other sensitive habitats; refer to the specific guidelines for each.
3. Provide the opportunity for recreationists to view wetlands from the trail to add visual diversity to the recreational setting.

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4. Utilize wetlands as a unique interpretive opportunity to explain the ecological and social significance of maintaining the integrity of wetland ecosystems.
5. Provide recreationists with a challenging experience on the trail to discourage use of wetlands.

Meadows

1. Avoid crossing meadows with trails.
 - 1.1 Locate trails in a position to view meadows from the trail, but discourage physical access to the meadow.
 - 1.2 Utilize interpretive signing to explain the ecological significance of maintaining the integrity of meadow systems.
 - 1.3 If meadows are crossed, utilize puncheon, corduroy, turnpiking, and/or above surface structures to prevent trail rutting and widening.
 - 1.4 Cross meadows at the narrowest point and utilize buck fencing or similar strategy to prevent off-trail travel.
2. Evaluate suitability of meadows for recreation stock grazing and determine utilization standards.
3. Select dispersed campsites in hardened areas.

Salmonid Spawning and Rearing Areas

1. Avoid locating trails and associated facilities that would contribute sediment or block fish migration to spawning areas.
2. Specific guidelines to prevent sedimentation of spawning areas, and barriers to spawning migration include, but are not limited to:
 - 2.1 Utilizing hardened stream crossings that minimize sedimentation, and provide up and downstream migration, such as:
 - Bridges.
 - Culverts (designed for fish passage).
 - Fords (designed for fish passage).
 - 2.2 Hardening approaches to stream crossings.
 - 2.3 Properly spacing, aligning, constructing, and maintaining waterbars.
 - 2.4 Outsloping trails, rolling the grade, and using drainage dips.
 - 2.5 Using corduroy, puncheon, and turnpiking through wet areas.
 - 2.6 Avoiding unstable slopes.
 - 2.7 Avoiding sidecast where material may reach the stream or cause failure of fill.
 - 2.8 Avoiding discharges from cross drains, relief culverts, and diversion ditches onto erodible soils or over fill slopes.
 - 2.9 Stabilizing cut and fill slopes, or other exposed soil areas with vegetation.
 - 2.10 Minimizing the number of stream crossings, and crossing at right angles to the main channel.
 - 2.11 Using full-bench construction and endhauling excavation if sidecast could reach stream.

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- 2.12 Maintain integrity of side channels; do not block or fill.
3. For trails and associated facility construction requiring work within the ordinary highwater line of state waters, obtain the appropriate Corps of Engineers and State of Oregon permits

Old Growth

1. Determine the occurrence of other key species and sensitive habitats; refer to the specific guidelines for each.
2. Locate trails to provide recreationists a sense of what old growth is without bisecting or fragmenting the stands.
3. Avoid locating trails near concentrations of standing dead (snags) and down material. These areas provide nesting, denning, and foraging habitat for a variety of species.
4. Take advantage of a trail located in old growth to interpret the complexity of old-growth ecosystems and their value to fish, wildlife and people.

Elk Calving and Deer Fawning Areas

Refer to elk and deer discussion in the Key Species section for guidelines concerning calving and fawning areas.

Spotted Owl Habitat Areas (S.O.H.A.)

1. Avoid locating trail or associated facilities in S.O.H.A.'s.
 - 1.1 If 1. is not possible, then avoid locating trails or associated facilities within 660 feet of the nest or core area.
 - 1.11 If 1.1 is not possible, then seasonally restrict access within 660 feet of the nest or core area during the nesting season (March through June).
2. Avoid blasting or chainsaw operation within 660 feet of the nest area during the nesting period (March through June).
3. Avoid locating trails through concentrations of snags and down logs; these areas provide nesting, denning, and foraging habitat for a variety of species which are often prey for spotted owls.
4. Utilize trailhead information boards to explain that trail passes through a S.O.H.A., but do not identify nest locations. Explain the reason for establishing S.O.H.A.'s and management objectives.

Elk and Deer Winter Range

Refer to elk and deer discussion in the Key Species section for guidelines concerning elk and deer winter range.

Pileated Woodpecker and Pine Marten Areas

1. Avoid locating trails or associated facilities through pileated woodpecker and pine marten areas.
 - 1.1 If 1. is not possible, then avoid locating trails in concentrations of snags and dead and down material since this is the primary habitat of these species.
2. When trails are located through pileated woodpecker and pine marten areas, provide trailside interpretation to explain the significance of these species and the habitat they represent.

People Habitats

Utilize Recreation Trail Planning Guidelines discussed previously to meet trail users' habitat needs for "travel corridors, home ranges, territories, browse, site attributes and preferences, edges, essential or critical habitats, diversity, and cover" (Clark, 1988).

General Planning Guidelines

The following guidelines can be applied to a variety of situations to meet fish and wildlife, and recreation trail objectives.

- In areas that have an existing high open road density (2.5 miles/square mile), try to locate trails parallel to open roads (100-200 feet apart) to minimize key species and sensitive habitat disturbance.
- To increase visual diversity and trail experience for the recreationist on parallel trail/road systems, weave the trail away from the road corridor to access unique features and challenge the user, then bring the trail back into the parallel position.
- Recognize that accepted trail location techniques that minimize future trail maintenance also benefits wildlife, for example:
 - * Locating trails on 25 percent or greater slopes to aid in surface water management also discourages off-trail travel.
 - * Riparian areas are often brushy and have moist soil conditions which require additional trail maintenance. Entering and leaving riparian areas in as short a distance as possible, reduces maintenance and benefits fish and wildlife.
- Avoid locating trails on "edges." Edges are places where different plant communities, successional stages, or stand conditions come together (Brown, 1985). Edges receive high levels of wildlife use because of the rich vegetative diversity (Fig. 6).
- Design twisting, winding trails with variable gradients and switchbacks. This variety on the trail challenges the user, and for motorized uses, reduces noise and speed of travel.

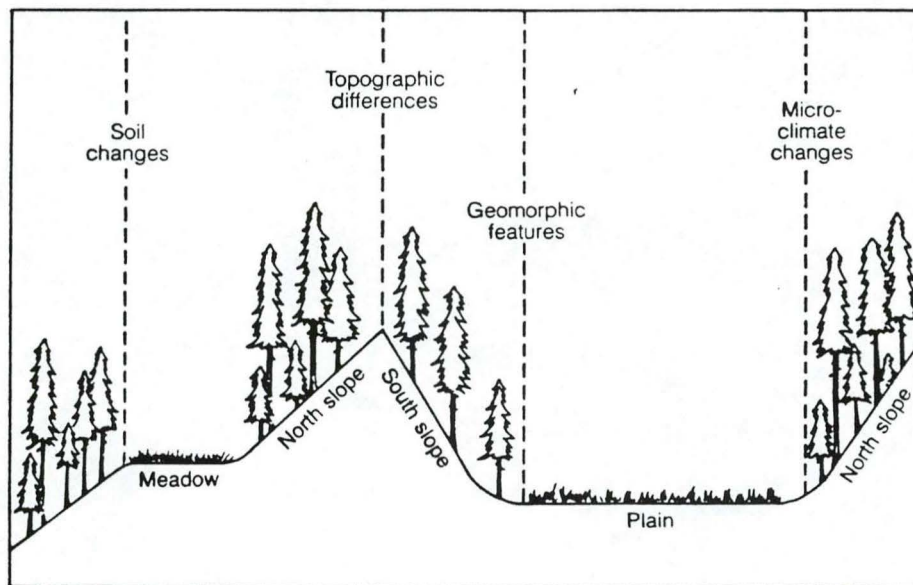


Figure 6 "Edges" where plant communities meet.

- Trail alignment should be curvilinear with straight stretches limited to 150 feet. By limiting the sight distance on a trail, the sense of discovery of "what's around the corner?" is increased.
- Avoid areas with snags. This will benefit wildlife, reduce construction costs, reduce maintenance, and reduce safety hazards.
- Utilize user-information boards at trailheads and trail associated campgrounds to inform users about fish, wildlife, and ecological values encountered on the trail system. Some ideas to consider are:
 - * View wildlife as you travel; wildlife are often disturbed when humans stop to view or photograph them.
 - * Highlight significant ecosystems that may be viewed from the trail, and emphasize their values.
 - * Consider the time of day, and season of the year that the facility is being used in relation to wildlife/human interactions.
 - * Leave pets at home or in camp. Dogs will mark areas which cause wildlife to avoid an area for days, and generally disturb wildlife by their presence and behavior.
 - * Educate users to act predictably on a trail. It's often the unpredictable behavior of a human/wildlife encounter that disturbs wildlife.
 - * Use information signs along the trail to explain sensitive habitats, or to explain why the trail avoids an area that can be seen from the trail, but not accessed.

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- * Locations of Threatened and Endangered species' nests and dens are exempt under the Freedom of Information Act; therefore, user information boards should not identify their exact locations.

IV. MONITORING

Development of a monitoring plan is the final step to integrating trail recreation opportunities with fish and wildlife resources on the Mt. Hood National Forest. This monitoring plan will address the validity of assumptions made during identification of key species, sensitive habitats, and trail planning guidelines.

Throughout the discussions of key species, sensitive habitats and trail planning guidelines, assumptions were made. These assumptions involved predicting the type of potential interactions between recreation trails, fish, and wildlife, and suggesting management practices to minimize or eliminate the negative impacts. An important feature of resource management is monitoring to determine the effectiveness of the management practices used, and the accuracy of the assumptions made. Monitoring allows the recognition of management project successes and permits discovery and adaptive correction of planning or implementation errors (Pendleton et al. 1987). Essentially, assumption monitoring is the process of identifying the assumptions to test, selecting sample sites, collecting physical information that reflects the assumption and interpreting the data.

Four assumptions were made during the identification of key species and sensitive habitats based on existing literature:

- (1) Recreation trails and associated facilities may affect reproductive success of key species.
- (2) Trail associated recreation may cause excessive energy expenditure of key species through agitated avoidance of recreationists.
- (3) Trail associated recreation may cause an unacceptable reduction in sensitive habitat quality.
- (4) High quality recreation experiences can be facilitated by the type of trail setting provided.

A fifth assumption was made while identifying trail planning guidelines:

- (5) Trail planning guidelines will maintain changes in reproductive success and habitat quality at acceptable levels.

Monitoring Plan

The objective of the following monitoring plan is to test the validity of the five assumptions identified above.

This plan outlines the monitoring method, unit of measure, monitoring frequency, and threshold of variability for each key species and sensitive habitat.

SPECIES AND HABITAT MATRIX

A. REPRODUCTIVE SUCCESS

OBJECTIVE: Determine whether key species are successfully reproducing.

| KEY SPECIES | MONITORING METHODS | UNIT OF MEASURE | MONITORING FREQUENCY | THRESHOLD OF VARIABILITY |
|--|---|---------------------------|----------------------|--|
| Wolverine | * | * | * | * |
| Peregrine Falcon | Breeding success: activity & productivity surveys | Numbers of fledglings | Biennial | Decrease in populations and/or suitable habitat below recovery plan objectives |
| Bald Eagle | Breeding Success: same as above | Number of fledglings | Biennial | Same as above |
| Gray Wolf | * | * | * | * |
| Spotted Owl | ** | ** | ** | ** |
| Greater Sandhill Crane | Breeding Success: same as above | Number of fledglings | Biennial | Decrease in population |
| Larch Mountain Salamander | Population composition, density and distribution | Individual | Biennial | Decrease in population |
| Salmonid fish & spawning areas | ** | ** | Annual | ** |
| Western Gray Squirrel & Merriam's Turkey | ** | ** | Annual | + or - 5% deviation from normal population fluctuations |
| Elk and Deer | Calving & fawning habitat use: pellet & species count | Number of animals & young | Annual | + or - 10% deviation from normal population fluctuations |
| Goshawk | Breeding success: activity & productivity surveys | Number of fledglings | Biennial | Decrease in population |

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| KEY SPECIES | MONITORING METHODS | UNIT OF MEASURE | MONITORING FREQUENCY | THRESHOLD OF VARIABILITY |
|--------------------|--------------------|-----------------|----------------------|--------------------------|
| Cooper's Hawk | Same as Goshawk | Same as Goshawk | Biennial | Decrease in population |
| Sharp-Shinned Hawk | Same as Goshawk | Same as Goshawk | Biennial | Decrease in population |

* Populations and densities are too small to accurately determine.

** Refer to Forest Monitoring Plan.

B. HABITAT AVOIDANCE

OBJECTIVE: Determine whether key species are avoiding useable habitat due to recreation trail disturbance.

Key species, methods, units of measure, frequency and threshold of variability are all identical to A. Reproductive Success.

C. SENSITIVE HABITAT QUALITY

OBJECTIVE: Determine whether the quality and useability of sensitive habitats has decreased due to trail recreationists.

| SENSITIVE HABITATS | MONITORING METHODS | UNIT OF MEASURE | MONITORING FREQUENCY | THRESHOLD OF VARIABILITY |
|------------------------------|--|--|----------------------|--|
| Cliffs, Talus & Caves | Breeding success & specie counts, photopoint | Numbers of fledglings/ numbers of animals & young | Biennial/ annual | Decrease in population/+ or -10% variation from normal population fluctuations |
| Riparian, Wetlands & Meadows | Breeding success/ specie counts/ line transect, photopoint | Numbers of fledglings/ annual key species, % ground cover, % plant composition | Biennial/ annual | Decrease in population/+ or - 10% variation from normal population fluctuation/ 15% loss of previously established vegetation/ 10% decrease effective ground cover |
| Old Growth | Same as above | Same as above | Same as above | Same as above |
| Elk and Deer winter range | Same as Elk and Deer in A. above | Same as A. above | Same as A. above | Same as A. above |

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| | | | | |
|---|-------------------------------------|---------------------|---------------------|------------------|
| Elk Calving and Deer Fawning Areas | Same as Elk and Deer in A. above | Same as A. above | Same as A. above | Same as A. above |
| Pileated Woodpecker & Pine Marten Areas | ** | ** | ** | ** |
| SOHAS | ** | ** | ** | ** |

****Refer to Forest Monitoring Plan**

D. RECREATION HABITAT QUALITY

OBJECTIVE: Determine whether the facilities provided (ie. trails, trailheads, campgrounds) are meeting the trail user's needs.

Conduct informal survey or formal PARVS survey. Survey design will vary with each project.

Monitoring projects should be pre-selected during project scoping. Criteria for site selection will vary between Ranger District based on local issues and priorities. However, sampling sites should be chosen based on the expected information that will be yielded. For example, when possible choose a monitoring site that is not confounded by other land management activities; this will help isolate the results to the monitored project. Monitoring should be done on a sample basis; every key species and sensitive habitat on every project is not expected to be monitored.

Unless project planning can be coordinated to allow extensive baseline data collection, information gathered to describe the existing situation, or affected environment will therefore provide the baseline data necessary to allow comparison between "before and after" conditions. During intensive field reconnaissance on pre-selected monitoring projects, field data should be gathered to describe current reproductive success, key species occurrence, and sensitive habitat quality. Essentially, the same measurements taken during intensive field reconnaissance on pre-selected samples should be repeated following project implementation to test assumptions.

Coordination between the Mt. Hood. National Forest personnel, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and user groups cannot be overstated. The specific monitoring design should be agreed upon, and once the information is gathered, it must be shared with interested parties. Conclusions should be discussed and consensus reached on the appropriate management action.

V.FUTURE RESEARCH NEEDS

As summarized in the literature review, the lack of quantitative documentation and research regarding all forms of trail associated recreation, and wildlife and fish interactions is a major obstacle to effective resource management on the Mt. Hood National Forest. Resource managers and the public need some definitive answers about recreation and wildlife/fish interactions in order to protect these resources for future generations. In the course of identifying key species, sensitive habitats, and preparing trail planning guidelines, several questions arose that could logically lead to future research projects.

- How do recreation trail use levels affect wildlife and fish species and habitats?
- How do the effects of roads relate to the effects of trails on wildlife/fish?
- What are the differences between various types of recreation use and interactions with fish and wildlife?
- How do the effects of winter recreation relate to the effects of summer recreation?
- What are the most effective methods for monitoring interactions between recreation and fish and wildlife?
- Can fish and wildlife habitat be protected through recreation management?
- What educational, informational and interpretive techniques are most effective in managing recreation, fish and wildlife interactions?
- What percentage does trail associated recreation contribute to the cumulative effects of timber management, mining, grazing, urbanization, and a growing human population on the overall reduction of fish and wildlife habitat?
- How can "people habitats" best be defined?

These study questions are intended to stimulate resource managers interest in acquiring more information to increase their wildlife, fish, recreation trail management ability.

VI.SUMMARY

In summary, the goal of this project was to fully integrate recreation, fish, and wildlife resources on the Mt. Hood National Forest into trail planning. A secondary, but less explicit goal was to demonstrate that protecting fish and wildlife, and providing recreation trail users with high quality settings are mutually beneficial. These goals were achieved by first reviewing the current literature on fish, wildlife, and recreation interactions, and then:

- Identifying key fish and wildlife species, and sensitive habitats on the Mt. Hood National Forest.
- Developing trail planning guidelines that address critical needs of key fish and wildlife species, sensitive habitats and trail users.
- Developing trail planning guidelines that emphasize trails users' needs, positive fish and wildlife interactions with trail users, and interpretive opportunities.
- Identifying monitoring procedures to validate assumptions concerning wildlife, fish, and recreationists needs, and test the effectiveness of trail planning guidelines.

Finally, some research needs were identified to help facilitate study in the future.

It is clear that successful resource management and public support for Forest Service programs in the future will depend on satisfying the National Forest's customers. This project provides the framework for resource managers on the Mt. Hood National Forest to integrate fish, wildlife, and recreation resources in a publicly acceptable manner.

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